

**DEVELOPMENT OF SCIENCE VIRTUAL TEST ON LEVELS OF
ORGANIZATIONS AND CELL TRANSPORT TOPIC (SVT-LOCT) TO
ASSESS JUNIOR HIGH SCHOOL STUDENTS' SCIENCE PROCESS
SKILLS**

RESEARCH PAPER

Submitted as Requirement to Obtain Degree of *Sarjana Pendidikan* in
International Program on Science Education (IPSE) Study Program



Arranged by
Wafa Hanifah
1503961

**INTERNATIONAL PROGRAM ON SCIENCE EDUCATION
FACULTY OF MATHEMATICS AND SCIENCE EDUCATION
UNIVERSITAS PENDIDIKAN INDONESIA**

2019

**DEVELOPMENT OF SCIENCE VIRTUAL TEST ON LEVELS OF
ORGANIZATIONS AND CELL TRANSPORT TOPIC (SVT-LOCT) TO
ASSESS JUNIOR HIGH SCHOOL STUDENTS' SCIENCE PROCESS
SKILLS**

**Oleh
Wafa Hanifah**

Skripsi yang diajukan untuk memenuhi salah satu syarat untuk memperoleh gelar
Sarjana Pendidikan pada Fakultas Pendidikan Matematika dan Ilmu Pengetahuan
Alam

© Wafa Hanifah
Universitas Pendidikan Indonesia
Agustus 2019


Hak Cipta dilindungi Undang-Undang.
Skripsi tidak boleh diperbanyak seluruhnya atau sebagian, dengan dicetak ulang,
difotokopi, atau cara lainnya tanpa izin dari penulis.

SHEET OF LEGITIMATION

**DEVELOPMENT OF SCIENCE VIRTUAL TEST ON LEVELS OF
ORGANIZATIONS AND CELL TRANSPORT TOPIC (SVT-LOCT) TO
ASSESS JUNIOR HIGH SCHOOL STUDENTS' SCIENCE PROCESS
SKILLS**

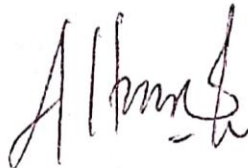
**Arranged by
Wafa Hanifah**

**Approved and Authorized by,
Supervisor I**



Prof. Dr. Hj. Nurvani Rustaman, M.Pd.
NIP. 195012311979032029

Supervisor II



Lilit Rusyati, M.Pd.
NIP. 198704202012122001

**Perceived by,
Head of International Program on Science Education Study Program**



Dr. Eka Cahya Prima, S.Pd., M.T.
NIP. 199006262014041001

DECLARATION

I do hereby declare with respect that every aspect is written in research paper entitled “Development of Science Virtual Test on Levels of Organizations and Cell Transport Topic (SVT-LOCT) to Assess Junior High School Students’ Science Process Skills” is genuinely pure result of my own original ideas, effort, research, work, and not copied or plagiarized from other papers. The opinions or findings of experts and others contained in this paper have been quoted or referenced based on scientific code from UPI and in accordance with ethical science that applies in scholarly society. This declaration is created truthfully and consciously, when subsequently is found an infringement towards scientific ethics, or if there is a claim of any others towards the authenticity of this research paper, hence I am willing to be responsible and accept academics sanctions correspond to applicable rules.

Bandung, 20 August 2019

Declarant,

A handwritten signature in blue ink, appearing to read 'Wafa Hanifah', with a stylized flourish at the end.

Wafa Hanifah

1503961

DEVELOPMENT OF SCIENCE VIRTUAL TEST ON LEVELS OF ORGANIZATIONS AND CELL TRANSPORT TOPIC (SVT-LOCT) TO ASSESS JUNIOR HIGH SCHOOL STUDENTS' SCIENCE PROCESS SKILLS

Wafa Hanifah
International Program on Science Education
Universitas Pendidikan Indonesia

ABSTRACT

Assessment of science process skills is one of the methods in developing students' level of process skills. However, the assessment of the issue could hardly be found especially in the specific topic of science. This condition prompted the researcher to develop and validate a test to assess students' science process skills in levels of organization and cell transport topic. In general, the development process of the test consists of 5 steps: (1) content analysis; (2) construction of multiple-choice test items; (3) readability test and validation by experts; (4) small group try out; (5) implementation of larger scale test. Based on the larger scale test, it was obtained the validity and reliability value, discriminating power, quality of distractor, and difficulty index. The subjects of this research are 7th grade students of private international Junior High School in Kabupaten Bandung. The total of the respondents was 118 students. The method of this research was developmental research. The validation of instrument resulted in 31 items that represent 8 skills and 27 indicators to assess students' science process skills on levels of organization and cell transport topic. The instrument is Science Virtual Test on Levels of Organization and Cell Transport (SVT-LOCT). The alpha Cronbach (α) is 0.753 and the correlation of R_{xy} is 0.63 which means that the instrument is considered as appropriate to assess students' science process skills. The result of students' science process skills also shows that 59% of the students have 'moderate' level of science process skills, and students' respond was positive.

Keyword: science virtual test, science process skills, levels of organization, cell transport

DEVELOPMENT OF SCIENCE VIRTUAL TEST ON LEVELS OF ORGANIZATIONS AND CELL TRANSPORT TOPIC (SVT-LOCT) TO ASSESS JUNIOR HIGH SCHOOL STUDENTS' SCIENCE PROCESS SKILLS

Wafa Hanifah
International Program on Science Education
Universitas Pendidikan Indonesia

ABSTRAK

Asesmen dalam keterampilan proses sains yang efektif dalam mengembangkan tingkat keterampilan proses siswa. Namun, hal tersebut sulit ditemukan terutama dalam topik sains tertentu. Kondisi ini mendorong peneliti untuk mengembangkan dan memvalidasi tes untuk menilai keterampilan proses sains siswa dalam topik Sistem Organisasi Kehidupan dan Transportasi Sel. Tujuan dari penelitian ini adalah untuk mengembangkan dan memvalidasi *science virtual test* untuk mengukur keterampilan proses sains siswa dalam topik Sistem Organisasi Kehidupan dan Transportasi Sel. Secara umum, proses pengembangan *science virtual test* terdiri dari 5 langkah: (1) analisa materi; (2) pembuatan instrumen tes pilihan ganda berdasarkan kemampuan proses sains; (3) uji keterbacaan oleh siswa dan guru, serta uji validitas oleh ahli; (4) Uji coba kelompok kecil; (5) uji skala besar. Berdasarkan uji skala besar, diperoleh nilai validitas dan reliabilitas, daya pembeda, kualitas pengecoh, dan indeks kesukaran. Subjek dalam penelitian adalah siswa kelas 7 sekolah swasta bertaraf internasional di Kabupaten Bandung. Total responden penelitian ini sebanyak 118 siswa. Penelitian ini menggunakan metode pengembangan penelitian. Hasil validasi instrumen tes menghasilkan 31 butir soal yang mewakili 8 keterampilan proses dan 27 indikator untuk menilai keterampilan proses sains siswa pada topik Sistem Organisasi Kehidupan dan Transportasi Sel. Instrumen ini disebut sebagai Tes Virtual Sains dalam topik Sistem Organisasi Kehidupan dan Transportasi Sel (SVT-LOC). Koefisien alpha (α) instrumen sebesar 0,753 dan koefisien Rxy sebesar 0.63 berarti instrumen dianggap sesuai untuk menilai keterampilan proses sains siswa. Hasil keterampilan proses sains siswa juga menunjukkan bahwa 59% siswa memiliki tingkat keterampilan proses sains 'sedang', dan siswa merespons secara positif terhadap SVT-LOCT.

Kata kunci: science virtual test, keterampilan proses sains, sistem organisasi kehidupan, transportasi sel

PREFACE

Alhamdulillahirrabbi'l'amin, all praises to Allah SWT, the cherister and sustainer of the world who has been giving His blessings and mercy to the author to complete the research paper entitled as “Development of Science Virtual Test on Levels of Organizations and Cell Transport Topic (SVT-LOCT) to Assess Junior High School Students’ Science Process Skills”. *Sholawat* and *salam* may always be delivered to the best human being, our prophet Muhammad SAW, to all his family, relatives, and also to all of the Muslims in the world till the end.

The research was conducted to develop the science virtual test item to assess students’ science process skills based on Rustaman’s and Rezba’s process skills. This research is partial requirements in Universitas Pendidikan Indonesia students in educational major to finish the study and to achieve *Sarjana Pendidikan*.

The perfection only belongs to Allah SWT, the author realized that the paper still has many unintended error that have to be improved. Therefore, suggestions to improve the quality of the science virtual test in the future is very much needed. Hopefully, this research paper can be useful and can be more improved by other researcher.

Bandung, August 2019

The Author

ACKNOWLEDGMENT

Alhamdulillah rabbil'alamiin, the researcher expresses the highest gratitude to Allah SWT for His blessings, opportunity, and mercy to complete this research paper. *Shalawat* and *Salam* are also delivered to our prophet, Muhammad SAW who has delivered the truth to human beings. The research and completion of the paper has been done with help, support, and cooperation from all parties concerned. The author would like to gratitude and appreciate to:

1. Prof. Dr. Hj. Nuryani Rustaman, M.Pd as the first supervisor who has devoted mind, knowledge, and time to help and guide the author to finish the research and completion of this paper. Thank you for the attention, knowledge, motivation, and inspiration, may Allah SWT repay all of your kindness and may you always be in good health, aamiin.
2. Lilit Rusyati, M. Pd as the second supervisor who has devoted mind, knowledge, and time to help and guide the author to finish the research and completion of this paper. Thank you for the attention, knowledge, motivation, and inspiration, may Allah SWT repay all of your kindness and may you always be in good health, aamiin.
3. Dr. Eka Cahya Prima, S.Pd., M.T. as Head of Department of International Program of Science Education and our Academic Supervisor. Thanks for guiding, motivating, and inspiring the author throughout studying in this program until finishing this research paper. May Allah SWT repay your kindness, aamiin.
4. My beloved parent and siblings for the never ending support, motivation, inspiration, guidance, and prayers. Thanks for always loving and caring on me. May Allah SWT always be by your side and repay all of your kindness, aamiin.
5. All of the lecturers of IPSE, Mr Eka, Ms Lilit, Mr Nanang, Ms Eli, Ms Rika, Mr Ikmanda, Ms Diana, Ms Resik, Ms Dea, and Mr Latief. Thank you for the guidance, knowledge, motivation, experience while the author was studying in IPSE. Hope Allah SWT repay your kindness, aamiin.

6. All of the teachers in Al-Irsyad Satya Islamic School, Mr Rudi, Ms Sarah, Ms Ina, Ms Gina, Ms Indah, for helping and guiding the author throughout the teaching practice. Thank you for the motivation, knowledge, experience.
7. Last but not least, all of my beloved friends IPSE 2015, especially Miftah Khairina Bahari, Mirani Rachmatika B, Selvi Nuraeni, Vania Zhafirah, Renita Novitasari, and Yurica Septianie, thank you very much for being one of the best parts of this journey that the author will never forget. Each one of you have inspired me to become a better person.

Bandung, August 2019

The Author

TABLE OF CONTENTS

APPROVAL SHEET	i
DECLARATION.....	ii
ABSTRACT	iii
PREFACE.....	v
ACKNOWLEDGMENT.....	vi
TABLE OF CONTENTS.....	viii
TABLE OF FIGURES.....	xi
TABLE OF TABLES.....	xii
TABLE OF APPENDICES	xiii
CHAPTER I INTRODUCTION.....	1
1.1 Background	1
1.2 Research Problem	5
1.3 Research Questions	5
1.4 Limitation of Problem.....	5
1.5 Research Objective.....	6
1.6 Research Benefit	6
1.7 Organizational Structure of Research	6
CHAPTER II LITERATURE REVIEW	8
2.1 Science Virtual Test	8
2.2 Science Process Skills	9
2.3 Levels of Organization and Cell Transport.....	13
2.3.1 Cell Structure and Function	14
2.3.2 Levels of Organization.....	19
2.3.3 Diffusion and Osmosis.....	21
2.4 Relevance Research	23

CHAPTER III RESEARCH METHODOLOGY	25
3.1 Research Method.....	25
3.2 Research Design	25
3.3 Research Subject	26
3.4 Operational Definition	26
3.5 Research Instrument	27
3.5.1 Rubric	27
3.5.2 Questionnaire	31
3.6 Instrument Analysis	32
3.6.1 Validity.....	32
3.6.2 Reliability.....	33
3.6.3 Difficulty Level.....	34
3.6.4 Discriminating Power.....	34
3.6.5 Distractor Analysis.....	35
3.6.6 Students' Attainment in Science Process Skills.....	35
3.6.7 Students' Impression	36
3.7 Research Procedure	37
3.7.1 Conception Stage	37
3.7.2 Instrument Development Stage	37
3.7.3 Application Development Stage	37
 CHAPTER IV RESULTS AND DISCUSSION	 39
4.1 Results	39
4.1.1 The Process of Science Virtual Test	39
4.1.1.1 Content Analysis	39
4.1.1.2 Construction of SVT-LOCT	41
4.1.1.2.1 The Initial Design.....	41
4.1.1.2.2 The Final Design.....	42
4.1.2 The Validity and Reliability of Science Virtual Test	43
4.1.2.1 The Validity of Science Virtual Test	43
4.1.2.2 The Reliability of Science Virtual Test	44
4.1.3 The Profile of Students' Science Process Skills	58

4.1.4 Students' Impression.....	61
4.2 Discussion	62
4.2.1 The Features of SVT-LOCT	62
4.2.2 The Reliability and Validity of SVT-LOCT.....	63
4.2.3 Students' Profile of Science Process Skills and Impression.....	66
 CHAPTER V CONCLUSIONS AND RECOMMENDATION.....	69
5.1 Conclusion	69
5.2 Recommendation.....	70
 REFERENCES	71
APPENDICES	78
AUTOBIOGRAPHY.....	173

TABLE OF FIGURES

2.1 Bacteria as Example of Prokaryotic	16
2.2 Eukaryotic cell with complete organelles	16
2.3 Nerve Cell (Neuron).....	17
2.4 Red Blood Cell.....	17
2.5 Sperm and Egg Cell	18
2.6 Root Hair Cell	18
2.7 Xylem and Phloem	18
2.8 Levels of Organization in Life	19
3.1 Prototyping Model Flow	25
3.2 Flowchart of Research Procedure	38
4.1 Example of Story Board of Interpreting in Article Form	51
4.2 Example of Story Board in of Classifying Figures Form	52
4.3 Example of Story Board in of Predicting Graph Form	53
4.4 Example of Story Board in of Raising Questions Video Form	54
4.5 Example of Story Board of Communicating in Table Form	55
4.6 Example of Story Board of Applying Concept in Video Form	56
4.7 Example of Story Board of Hypothesizing in Figures Form	57
4.8 Example of Story Board of Planning Experiment in Videos Form	58
4.9 Frequency distribution of Students' Science Process Skills	60
4.10 Average Score of Skills	61
4.11 Average Score of Sub-Topics	61
4.12 Students' Impression After Conducting SVT-LOCT	63

TABLE OF TABLES

2.1 Skills of Science Process Skills	11
2.2 Analysis of Core Competence and Basic Competence on Levels of Organizations Topic	13
2.3 Analysis of Cambridge Syllabus on Levels of Organizations and Cell Transport Topic Research Questions	13
2.4 Cell Organelles and Function.....	15
3.1 Rubric for Experts' Judgement in Media.....	28
3.2 Rubric for Experts' Judgement in Content	29
3.3 Rubric for Experts' Judgement in Education.....	29
3.4 Rubric for Experts' Judgement in Language	30
3.5 Rubric for Teachers and Students' Readability Test	30
3.6 Questionnaire of Students' Impression.....	31
3.7 Validation Interpretation Value.....	33
3.8 Interpretation of Cronbach formula	33
3.9 Interpretation of difficulty index.....	34
3.10 Interpretation of Discriminating Power	35
3.11 Categorization of Students' Attainment	36
3.12 Interpretation of Likert Scale	36
4.1 Blueprint of the 27 indicators of Science Process Skills	39
4.2 The Blueprint of Initial SVT-LOCT Design.....	40
4.3 The Blueprint of Final SVT-LOCT Design	41
4.4 Result of Reliability Test by SPSS 24	44
4.5 Discriminating Power of Small Group by ANATES 4.1.0.....	45
4.6 Discriminating Power of Large Group by ANATES 4.1.0	45
4.7 Difficulty Index of Small Group by ANATES 4.1.0	46
4.8 Difficulty Index of Small Group by ANATES 4.1.0	46
4.9 Descriptive Statistics of Students' Science Process Skills	58
4.10 Levels of Science Process Skills	59
4.11 Students Impression of SVT-LOCT	61

TABLE OF APPENDICES

Appendix A Story Board of SVT-LOCT	78
Appendix B Result Recapitulation of Experts' Judgment	86
Appendix C Teachers' and Students' Readability Result	112
Appendix D Revision I of SVT-LOCT	135
Appendix E Validity Result of Small Group Try Out	138
Appendix F Revision II of SVT-LOCT	141
Appendix G Validity Result of Large Scale Test	144
Appendix H Average Score of Each Science Process Skills	146
Appendix I Recapitulation of Students' Impression	148
Appendix J Judgment Sheet	150
Appendix K Review Form	156
Appendix L Documentation	158
Appendix M Permission Letter	160
Appendix N Turnitin Revision	164